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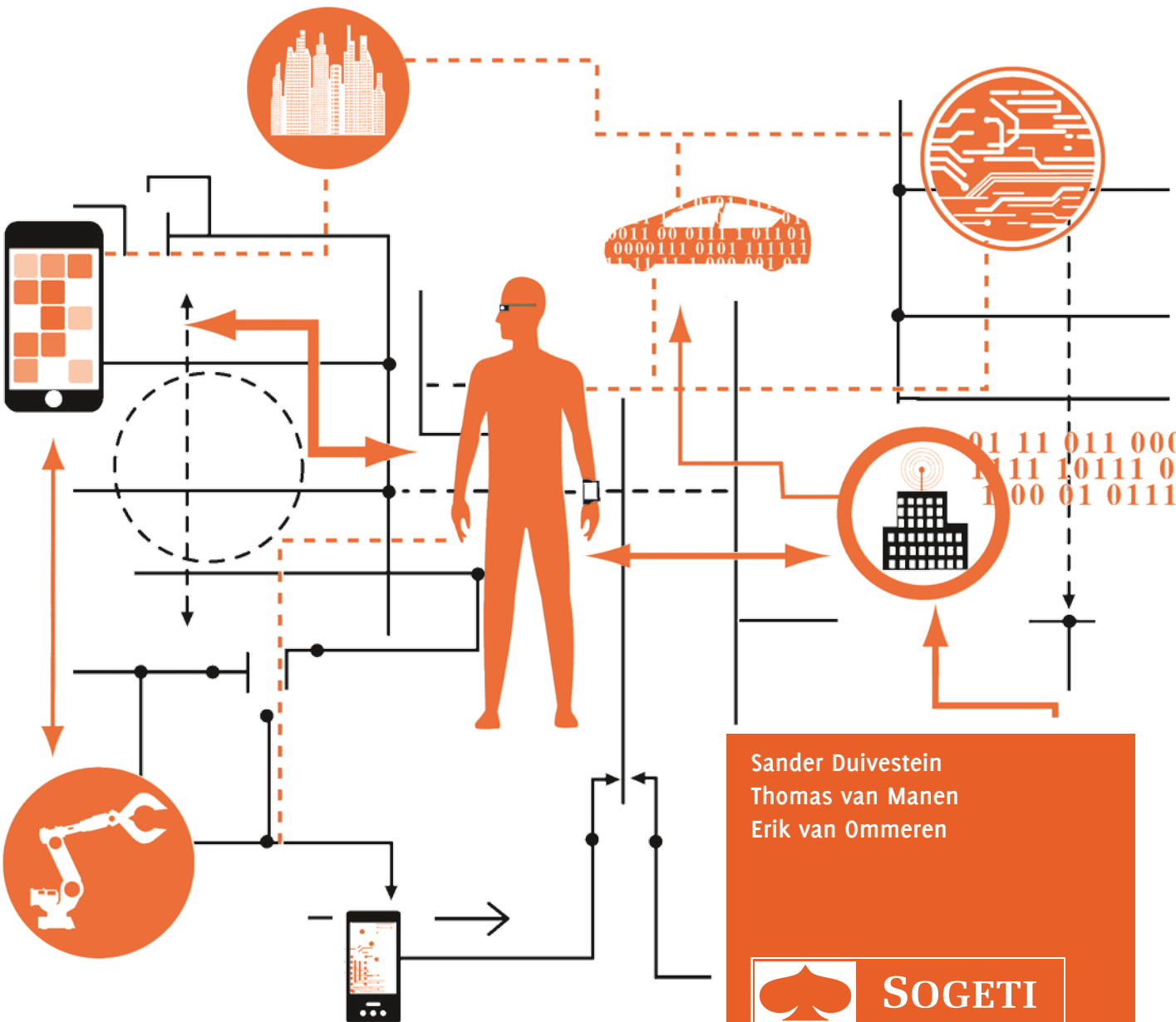
EMPATHIC THINGS

Intimate Computing from Wearables to Biohacking



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Four New VINT Reports on Things Digital

At the end of the last century there were rumors buzzing about that "Things were coming on the Internet." Due to the long nose of innovation, as Bill Buxton of Microsoft Research put it, it took another fifteen years, but today the news is all over the place. Start-ups and illustrious names are claiming breakthroughs in all shapes and sizes: from the off-the-shelf sensor hardware of Arduino and Libelium, to McKinsey and IBM.

Since time immemorial the relationship between man, his artefacts and the ambient world has been a hot item. The difference is that today we have the gift of programming and the ability to accommodate everything in cyber-physical systems. This makes it concrete: from smartphones and intelligent pillboxes in health-care chains to the lifecycles of products and customer-oriented services, from science fiction to fact of life.

Since 2000 the world has changed radically a number of times, and keeping up with the developments is no picnic. Social networks, mobile platforms and apps, advanced analytics and big data, cloud computing and the artificial intelligence of IBM's Watson. All this taken together is SMAC – and now our THINGS are next. SMACT ("smacked") is a thunderous breakthrough. Innovation always takes longer than expected, but miniaturization, cheap sensors, smartphones in billions of people's pockets, autonomous systems, better batteries, self-driving cars and smart software in the cloud demonstrate that it is beyond doubt: SMACT is already a *fait accompli*.

VINT is devoting four new studies to this mega-theme. *THINGS: The Internet of Business Opportunities* was the first study. The second one, which you have before you, deals with Empathic Computing in light of what Google calls Augmented Humanity. Everything can be reduced to the human-to-machine (h2m), machine-to-machine (m2m) and machine-to-human (m2h) chains, in simple and complex event-and-process chains.

SMACT is the advancing reality of automation that increasingly interferes with life itself. But smart cities, artificial intelligence, smartphones, digital surveillance, etc. are not without risks. For this reason – and despite technological capability and organizational feasibility – we also consider economic practicality and social advisability. For the bottom line of the lesson is that it is not just a matter of making smart things – but rather of doing smart things.

"If you see somebody begging under a bridge you might feel sorry for them or toss them a coin, but that's not empathy, it's sympathy or pity. Empathy is when you have a conversation with them, try to understand how they feel about life, what it's like sleeping outside on a cold winter's night, try to make a real human connection and see their individuality."

Down and Out in Paris and London

George Orwell, 1933

1 The Age of Empathic Things

In this second study on Things, VINT explores the coming transition toward a more empathic form of computerization. In the past few years, information technology has become increasingly personal and social, and has made its presence very much felt. The emergence of wearable computing and other forms of empathic "things" seems a logical next step: even more intimate, human-oriented and ubiquitous. There are more and more devices that count our steps, take our blood pressure or measure the indoor temperature, track our location or conversations. We are witnessing a computer boom in devices of all kinds, shapes and sizes – around, on or inside the body – that behave increasingly smarter and link up more and more intuitively with mankind's extremely personal and natural interface. Or, as IBM puts it:

"A host of technologies are coming that will help us overcome our limitations and will transform the way we interact with machines and with each other".

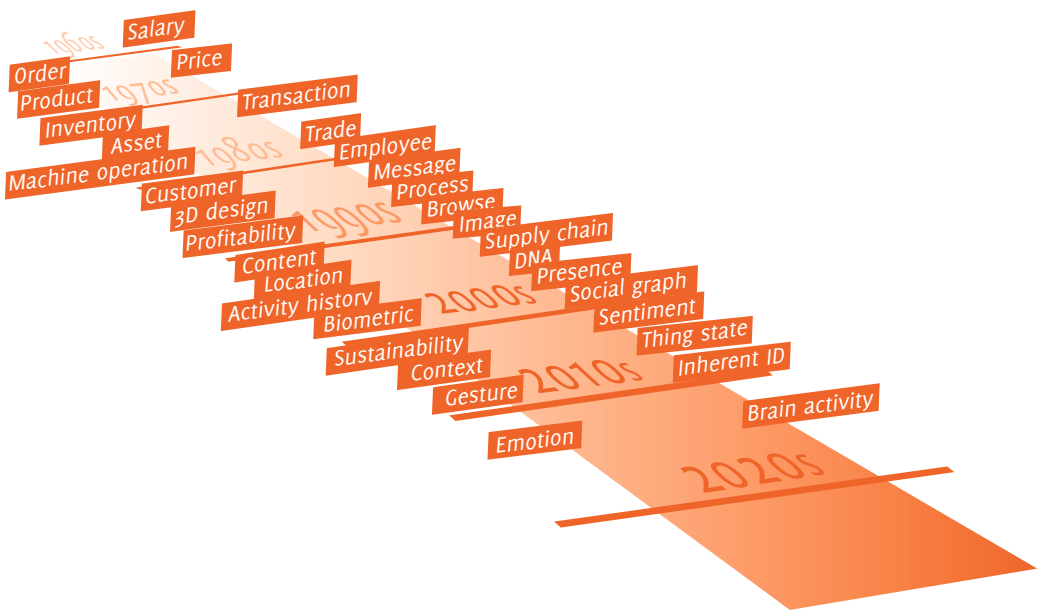
We are offering a look into the latest phase of the post-PC era: where the fighting flares up for the new form factor, where the foundation is laid for new ways of communicating between man and computer, where Bring Your Own Wearable Device (BYOWD) constitutes a challenge for organizations and the Systems of Engagement will develop their empathic ability to a high extent. In the next decade, Personal Computing will become really personal: inside, on and around the user, and attentive to the individual context. It is an evolutionary development:

- it will further change the way organizations and consumers, states and citizens, companies and employees treat one another, and make it more intimate;
- it abounds with paradoxes and raises big questions that cannot be answered off-hand, like, "Shall we have more control of our (digital) lives, or shall we be increasingly ruled by computers?";
- it will no doubt be accompanied by a large number of failed market introductions before the right forms and applications are found.

To us, Empathic Things is an umbrella concept. It includes a wealth of manifestations that are all viable in a technological and design-technological sense, but not all

of which are socially desirable and economically practical in this post-PC era. The key question is under what conditions would they seem appealing, or, conversely, so unappealing that we would avoid them. It is up to each person to make individual choices: from Fitbit and password rings or pills, to biohacks or digital tattoos, and smartphone apps that measure our sleeping rhythms – whether or not through smartwatches. Empathic Computing and Things are part of a long history, an evolutionary development toward computers that are better able to show empathy in relation to people. Currently, this is still extremely experimental and primarily a matter of "playing with the possible." But the direction in which the information society is developing is becoming apparent: closer to the skin and more tailored to our personal situations.

Initially only financial and product data were saved in databases; today, however, we can even record emotions and brain activity, thanks to advancing technology. A consumer's intentions, perceptions, actions and reactions, facial expressions, heart rate – all these personal data are coming within arm's reach of the information society. This provides a new potential in terms of competitiveness, as described in the report *Strategic Information Management for Competitive Advantage*, by Gartner analyst Mark Raskino. Fifty years of IT history have demonstrated this development: from payroll-related data, ERP systems and process automation, to "social" data including an individual's state of mind, as represented below in the journey through history.



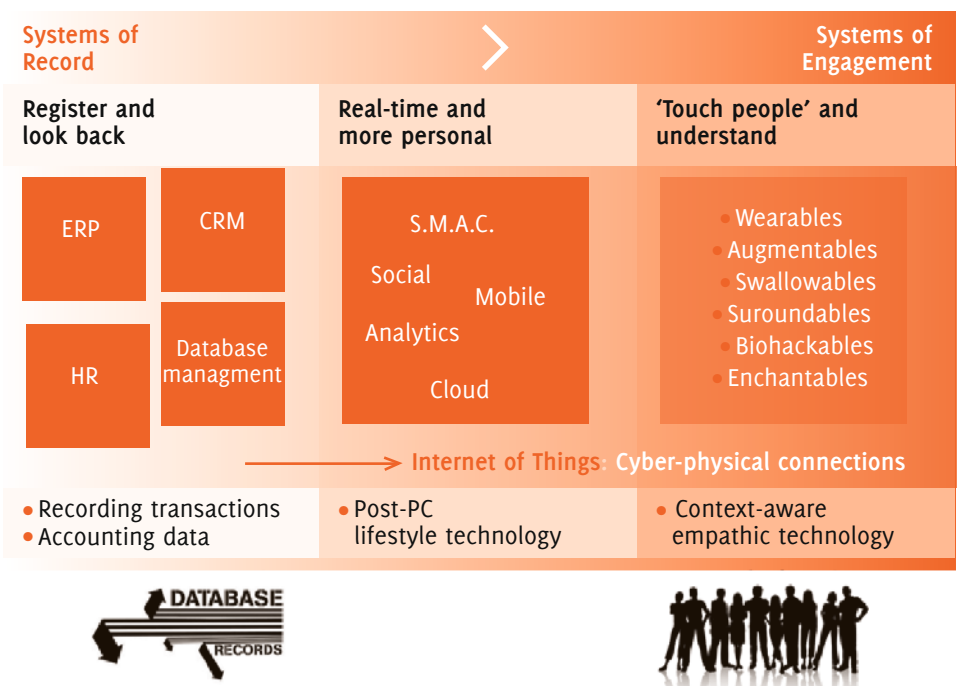
Source: Mark Raskino, Gartner, 2012

In this development, the Internet of Things is playing a crucial part. Clearly the products that enable people's perception of their environment to be incorporated into IT

systems are developing. It is tricky to predict the exact impact on business, but the direction of the development is becoming apparent. The key idea here is context. If one is aware of the context in which a consumer uses a product, and the consumer's emotional state of mind when entering a store, new avenues open up for making current IT systems more efficient, effective and personal.

The major effect is on empathy. Beside the IQ, the Intelligence Quotient, there is also the EQ, the Emotional Quotient of emotions and relationships. To be truly successful, one must do well on both scores. The same goes for systems: "showing correct information" is no longer the goal. The goal is also to empathize with individual consumers: what are their intentions, what is needed to help them in this or that situation, how to create an even better *perception* that ensures that a given customer remains loyal to a business?

Systems have witnessed a shift from simple bookkeeping (the System of Records) to the front desk: the interaction between company and customer (the Systems of Engagement). Where these systems may not have been so very "*engaging*" at first, there is much more personalization, proactive support and room for the human dimension.



Source: VINT, 2014

Empathic Computing may well herald an accelerated development. A more subtle and balanced insight into the behavior of each individual will enable us to define the context of each interaction in such great detail that our systems can demonstrate true empathy, responding to the situation as well as the customer's state of mind. Knowledge of the intimate context can make or break this form of hyper personalization.

The technology to enable this is part of a trend that is becoming more and more apparent: more social, closer to the individual, growing in terms of supply, more and more desired and less of a gadget, and increasingly part of smart ecosystems.

The opportunity to focus attention on individuals has long been an ardent wish of many organizations. For ages, the strategic plans of the majority of businesses have been all about the customer. That this obvious point is now back on the agenda, in light of technological advancements that are becoming increasingly human, may well illustrate how far organizations have drifted from their mission.

In this study we explore this development and present seven manifestations that can define the impact on business, such as the "quantified employee" and the "body as the new password." The "things" that come into play in this context involve technologies that are much closer to the skin, from "enchanted objects" and "surroundables" to the biohacking techniques that aim to extend the human limitations. These new manifestations are evolutionary steps of Empathic Computing.

The discussion on what Empathic Things actually mean is heating up. We tend to follow the definition of the international consortium of computer scientists IWEC, a collaboration of experts in the fields of affective computing, Internet of Things, ambient intelligence, sensor networks and psychology:

> *"Empathic computing systems are software or physical context-aware computing systems capable of building user models and provide richer, naturalistic, system-initiated empathic responses with the objective of providing intelligent assistance and support. We view empathy as a cognitive act that involves the perception of the user's thought, affect, intention or goal, activity, and/or situation and a response due to this perception that is supportive of the user. An empathic computing system is ambient intelligent, i.e., it consists of seamlessly integrated ubiquitous networked sensors, microprocessors and software for it to perceive the various user behavioral patterns from multimodal inputs."*

It is where these "things" find themselves (inside, on or around the body) and what data they collect that decides their specific application. The fact that new and current IT players are creating a true gold fever around this phenomenon definitely increases the chances of a breakthrough, but by no means guarantees success. We describe a variety of courses currently being taken, but also failed attempts to introduce "things" in the past. The business-related consequences that are discussed afterwards reveal low-hanging fruit, e.g., easy opportunities to combat all sorts of waste, and context is the central theme. But at the same time we feel we ought to be cautious about the potential bottom-up force of Bring Your Own Wearable Device in organizations. We conclude with the paradoxes and side-effects and seven foreseeable truths that may define the new information society.

2 Empathic Things: Inside, On and Around the Body

Empathic Things are devices that are capable of displaying empathy toward humans: being aware of our feelings, thoughts or experiences, even though we have not explicitly communicated them. It would be great if empathic computer systems were more useful to us thanks to those skills, but it could become scary if they know too much about us. In the world of the Internet of Things, these two dimensions are both intensified. Being close to and sometimes even under the skin, they create a more intimate relationship and more personal data. The possibility of being more useful is equally strengthened, for the very reason that the "things" are near us and are able to register what we are experiencing at the time.

These two dimensions are well illustrated in the recent example of the Dutch passenger bus firm Beuk. They claim to have the world's first system to detect fatigue in coach drivers during the long rides to the holiday sun. The Australian supplier Seeing Machines started a pilot in conjunction with Beuk to monitor drivers' behavior behind the wheel, where the drivers' facial expressions are constantly monitored. If drivers show signs of weariness, they get shocks from the driver's chair, and the relief driver in the sleeping compartment also gets a signal. Research shows that one quarter of the drivers tend to doze off at the wheel at one time or another. Undesirable behavior like drivers operating their mobile phones or scanning for radio stations is also recorded. Deviant behavior is sent to the server at headquarters. Initially the idea that the company could constantly watch them in the cabin caused some apprehension among the drivers. Beuk's enthusiasm for the technology, incidentally, may well be due to the price: € 5,000 per bus is in fact one third of the price of other products available in this sector so far.

Empathic Computing devices are available in all shapes and sizes – inside, on or around the body. The device's location and the kinds of data they record define their specific characteristics. They are aware of their own context as well as that of their user, and link up perfectly with the extremely personal and natural interfaces of individuals, thanks to an increasingly intelligent and intuitive network.

The convergence of Social, Mobile, Analytics, Cloud and Things enables us to offer services even more tailored to the customer. However, the dividing line between wearable and unbearable seems very thin indeed.

Analysts have no doubt that in the coming years the market will be flooded with a whole range of this kind of personal devices. The impetus is coming from the technology industry. In the face of declining or disappointing sales of smartphones and tablets, a struggle is being waged for the consumer's wrist (smart watch), his nose (smart glasses), or even his brain (the smart wig: there are real patents that suggest

companies are interested in exploring wigs that record brain activity). Technology businesses such as Apple and Google, but also, for example, Samsung, Sony, Microsoft, LG and Intel, are all setting ambitious goals by putting products on the market as quickly as they can. It will soon become clear whether this hype will indeed translate into consumer attachment and these new Empathic Things will become as indispensable as today's smartphone.

Although the sales figures for tablets in the fourth quarter of 2013 exceeded those of PCs for the first time (84.1 million tablets versus 83.1 million PCs), we are now witnessing an "upgrade fatigue." While the post-PC age has finally begun, the industry is already craving a new form. Evidently, the smartphone user today tends to be less inclined to replace the device with the latest model again and again. In addition, there is a lively trade in second-hand phones, and the prices of new smartphones firm up on a lower level than before, which tends to put pressure on the margins.

It remains to be seen whether innovations such as the Google Glass will experience as steep an adoption curve as the smartphone. A recent consumer poll by BITE Interactive (May 2013), for example, shows that only one in ten American smartphone users considers wearing the Google Glass on and off and 38% of the interviewees indicate they will never use the device, whether it is affordable or not. That is food for thought. Still, when the mobile phone was introduced, skepticism was also predominant at first, and this kind of study turned out to be unreliable when it came to predicting the future.

We can distinguish six manifestations of Empathic Things, depending on the location (inside, on or around the body) and the kind of data involved:

Swallowables – technology *inside* the body that provides internal physical data with an interface. Motorola, for example, has developed a digital pill in conjunction with Proteus Digital Health. When it is swallowed, the pill generates the required electricity on the basis of gastric acid, using magnesium and copper electrodes. Once inside the body, the pill emits a unique 18-bit signal that can be used as an "authentication token." In this way the pill makes the body a digital identity certificate that can be used to gain access to spaces, computers or files. Thus the technology in the user's environment can identify the individual automatically and adjust its interaction accordingly. More functions are conceivable. For example, special pills for cardiac patients could provide constant monitoring of blood circulation and temperature. A pill named CorTemp has an Ingestible Core Body Temperature Sensor with a battery and wireless transmitter measuring and sending the body temperature in real time. This is not science fiction: firemen, soldiers and astronauts use the pill. HQ Inc., the manufacturer of the pill, expects to put a consumer version, collecting data that can be read out by means of a smartphone app, on the market soon.

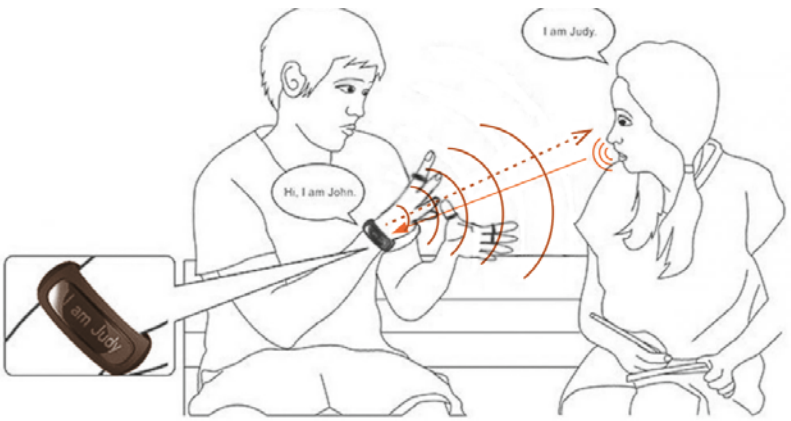
Wearables – The most visible form of wearable technology is the present generation of wearables that primarily focuses on internal physical data. Examples already on the market are the activity trackers of JawBone, Nike and FitBit, but also the smartwatches of Samsung and Pebble. The current generation of smartwatches is rather similar to older activity trackers in terms of functionality, but as the interface is getting better and richer, they are increasingly moving in the direction of Augmentables.

Until now, the point of departure in the case of wearables has been their technological possibilities. The objective seems to be to introduce a product as quickly as possible: more often than not it involves a number of sensors and a battery, packed in a cheap casing. People wear the wearable on the body like an armband or with a clip, after which the monitoring can start. Information is passed on to an app, and can be shared online if so desired. This current wave of wearables is still limited in terms of functionality and usefulness. Restrictive factors such as wearability, design and quality of the materials used still stand in the way. Yet plenty of experiments are taking place with this first generation, primarily to keep an eye on the health (and health-related costs) of employees.

The development of wearables does not stand still and the current glasses, watches and armbands are just the beginning. The functionality of wearables is determined by underlying technologies such as sensors, smart materials, and automatic recognition of gestures, eye movements, or speech. As they improve, more advanced wearables will be put on the market. A next step could be the *digital tattoo*, for example, applied on the skin to measure what happens beneath the skin – from blood circulation to heart rate, body temperature and even brain activity.

As wearables become more commonly available, the applications will also become more sophisticated. The future of wearable rings or bands is the Sign Language Ring. This set of rings and an armband reads gestures and renders gestures into voice. The

reverse works as well: it translates spoken sentences into written text that can be read off the screen of the armband. The idea, which was developed by a group of Chinese scientists at Asia University, is still in its early stages, but is nevertheless so ingenious that it was awarded a Red Dot Design Award for the best Design Concept of 2013.



Source: Red Dot Design Concept Awards 2013

A very sophisticated wearable is Google's "smart contact lens" for diabetics. Using a tiny chip and sensor system, the lens measures the amount of glucose in the aqueous humor of the patient. This way the blood sugar level can be monitored at all times without the use of a needle or log monitor. Wearable Things are very useful for this type of invisible monitoring. Microsoft and the University of Washington were working on a similar project.

A serious problem with the current generation of wearables is their data isolation. The sensors provide a wealth of measured data, but it cannot be integrated with other devices or applications. As yet there is no such thing as a personal umbrella ecosystem within which all data flows are amassed in a smart way. Little wonder, therefore, that the American manufacturer of sportswear and fashionable underwear Under Armour has taken over a company that enables people to follow their data online: the sensors incorporated in underwear by Under Armour are virtually worthless without a way to read them out and integrate them, in due course, with other Empathic Things such as trainers or fitness equipment.

Surroundables – Surroundables involve the combination of internal physical data and the user's environment. Nissan, for example, is experimenting with a smartwatch, the Nismo watch, aimed at making driving a car safer. The smartwatch supplies the driver with specific information by means of a special app on the smartphone: information such as the average speed, fuel consumption and the maintenance schedule of the car. In addition, the Nismo keeps tabs on biometric data such as heart rate and body temperature, so that drivers can see how fit they are.

Source: Nissan, 2013

Wired magazine provided some insight into what the impact of such a system might be at the end of the day. In their article on the Nismo smartwatch we read that one fifth of car accidents in the UK is caused by tiredness, which is why manufacturers regard the drivers as attractive potential buyers. *Wired* believes that the Nismo or a similar device will eventually be made compulsory. Another point of attention, however, is road safety:

> *"Then again, looking away from the road at any point during driving, whether it be to check your phone, change the radio station or even to glance at a sat-nav, can be dangerous, so there's also the chance the watch could prove to be another distraction."*

A second form of surroundable is "smart fabrics" or "smart clothing." CuteCircuit of London has developed a concept for a mobile-phone dress with antennae in the seams and a SIM card in the label. Scientists in Italy, France and the USA have even developed a dress of which the fabric was coated with nano particles and polymers that together form electronic circuits: the dress as a computer instead of a dress with a built-in computer. A further step could be that we have clothing that changes color depending on the environment and/or biometric data, clothing that measures *and* regulates our body temperature, and clothing that charges the devices we are wearing. And what about smart clothing that gives a signal when the wearer is coming within the range of a CCTV camera or a drone, and prevents the wearer from being recorded.

Biohackables – Arguably the most evolutionary variation of empathetic things aims to transcend human limitations: Biohackables. This technology is implanted in the body to extend human capabilities. For example, in 2013 34-year-old Rich Lee had magnets implanted in his tragus, the small pointed protrusion of the outer ear; in combination with a necklace, they function as built-in loudspeakers. Or consider the fingertip of Lepht Anonym, a biohacker and transhumanist: by cutting her own finger with simple tools and inserting all kinds of sensors subcutaneously, she is developing new senses. She has small metal discs in her fingertip to detect the form and strength of electromagnetic fields.

Tim Cannon is another trendsetter in this field and in conjunction with Grindhouse Wetware he has built a chip that measures all kinds of biometric data. The Circadia measures body temperature, among other things, and notifies the wearer when there is a flu coming on. All data are passed on via Bluetooth or a WiFi connection. Cannon inserted the chip – the size of a smartphone – in his arm with the help of a colleague bodyhacker.

Source: Grindhouse Wetware, 2013

Cannon expects that this kind of device will help him connect with his body more than before. But the automation of his environment plays a major part as well. Cannon is developing a device that detects whether a person feels tired or energetic and can respond by adjusting the lighting or playing a particular kind of music.

The experimental phenomenon of biohackables borders on transhumanism, the movement that sees technology as an aid to transcend human limitations and restrictions. It is not for nothing that biohackers like to be designated as cyborgs.

Apart from technological, biological and medical challenges, this obviously raises ethical questions. Sadie Creese, director of the Global Centre for Cyber Security Capacity, expects that in the future all kinds of chronically ill patients will be implanted with medical devices: "They will be measuring vital signs, reaching back to the health care providers, whoever that might be and wherever they're based. So you can imagine consultants and doctors around the world, or your local doctor, firing up a single app and being able to receive alerts on a patient," says Creese.

Augmentables – The first examples of Augmentables are emerging, but the majority of these products are still kept within the walls of R&D departments or find themselves in a beta phase: Google Glass and the alleged Apple iWatch, for example. This category uses data from a user's environment and aims to complement and intensify

the senses. Google Glass complements the physical world that we observe around us by supplying digital information. The glasses mediate between the user and the environment. As soon as a broad-based acceptance of Glass is a fact, this will create opportunities for various new kinds of advertising. In addition, Google has been issued a patent for a so-called "Gaze Tracking System," which makes it possible to ascertain – by means of Glass – which advertisements catch the user's eye. In combination with other data, this may be an option to find out how people react emotionally to commercials.

There are opportunities for Glass in cases where situational information or interactivity are important. Philips, for example, has come up with a Google Glass application that enables the surgeon to check a patient's records during an operation. This is of immediate value: the surgeon has direct access to the patient's vital functions and the health-care provider can download images and other patient data, no matter where he finds himself in the hospital. He can have a live video conference with another surgeon and share images instantly of what he comes across during an operation. In addition, interning physicians can watch an experienced surgeon perform an operation.

In October 2013 surgeon Marlies Schijven of AMC (Amsterdam Medical Center) University Hospital performed an operation wearing the Google Glass. Images were transmitted to the Games for Health Europe conference, where another surgeon could follow the operation with his own Glasses, while at the same time the images were projected on a screen for a larger audience.

Source: Philips, 2013

Another example in this category is the NorthPaw, an ankle tag that tells the user by means of vibrations where the magnetic north is. It is interesting that after wearing it for a month the users indicated that, like homing pigeons, they "sensed" where the north was. So they seemed to have developed an extra sense: augmentation *in optima forma.*

Enchantables – This last category comprises everyday objects that are of use to people in their own environment, but which are now equipped with intelligent technology: Enchantables, also called Ambient Technology.

GlowCaps from the Vitality company are a prime example. A major problem in health care is that people do not take their medicine in a timely way, or they even forget to take it altogether. In some cases this leads to serious and often expensive complications. To solve the problem, Vitality developed a smart medicine box that is internet-connected. The lid contains a sensor: it registers the cap being opened, and can trigger an LED light that will call for attention by flashing. When it is time to take your medicine, you are alerted to it by the flashing light. If the patient has failed to take the medication after a while (i.e., if the box has not been opened yet) it is time for extra measures: sending a text, perhaps to a caregiver, depending on the seriousness of the situation.

A second example is the Amazon Trash Can, a smart trash can that scans every thrown-away item and re-orders it if necessary. This is a project of the MIT Media Lab as part of the Ambient Furniture project.

But we also come across enchantables in architecture, to enhance livability and social interaction. Designer Daan Roosegaarde is well known for his project Intimacy 2.0, among other things. This is a dress that becomes transparent depending on the wearer's activities. He also designed digital meeting places for squares and streets, such as "marbles" (functioning as a public fireplace) and "sensor valley," a kind of digital hugging pole.

'Marbles' by Daan Roosegaarde– interactive meeting place in Almere
Source: Daan Roosegaarde, 2013

Enchantables turn ordinary things into something extraordinary while adding some extras: aiming for more user-friendliness, better interaction or better and effortless information. The essence is that the objects remain as true as possible to their original forms and functions, but offer (usually subtle) additional interaction that is useful to the user. To categorize these Empathic Things, David Rose of MIT uses the following eleven characteristics that may be present in an Enchanted Object to a greater or lesser degree:

- Glanceability – you can absorb information with a quick glance
- Wearability – the enchantables are "wearable"
- Usability – user-friendliness is central
- Loveability – you can build a bond with them
- Tangibility – you can touch them
- Learnability – they learn from interaction
- Expressability – they can recognize facial expressions
- Gestureability – they recognize gestures
- Ingestability – they can be swallowed
- Affordability – the price is reasonable
- Sociability – they are accepted socially

What Empathic Things have in common

It is true of all six categories that the technology plays a major part in the way the user interacts with information and the environment. As technology is close to the senses, these Empathic Things co-contribute in determining our view of and interaction with reality. Ideally, the technology is practically invisible and we experience

the contact with digital information in a manner similar to the way we treat things or people. In that sense, humans and technology have a symbiotic relationship. They should be perfectly aligned with one another, however, in terms of the data exchange between device and individual but also in terms of a sense of what should happen when. Anyone who has washed his or her hands under a tap with a sensor, or made a paper towel appear from a device with an "eye," knows how very delicately tuned such a device can be: if it interprets our intention correctly, the experience is obviously natural and magical, but as soon as it goes wrong, we consider it a useless obstacle and tend to get angry or frustrated.

The technological ecosystem that enables Empathic Computing concerns all layers of our current society, adding a new layer on top of all that, a layer of sensors and actuators:

Transducer/Transformer – New technology supporting the interaction between the senses and digital information, such as multi-touch displays, electronic paper, gyroscopes, Haptic interfaces, head-mounted displays, Smart fabrics, micro displays, muscle-computer interfaces and brain-computer interfaces. A term commonly used in this context is MEMS: Micro Electro Mechanical Systems – miniature devices with physical and digital functions.

Algorithms – Technology to establish human behavior, characteristics and idiosyncrasies such as speech recognition, biometric input systems, Glance and gesture recognition, embedded GUI, face recognition, speech-to-speech translation, natural language processing, mood recognition, behavioral analytics, machine learning, emotion detection & recognition.

Systems – Hardware and software capable of functioning autonomously, such as virtual assistants, robots, wearables and chip implants.

3 A Long Way to a Real Breakthrough

In the rat race of new devices, innovation reigns supreme on the market with an enormous multiplicity of applications. How long will it take before we are all walking about with digitally connected glasses, contact lenses or even chips in our brains? Will there be hundreds of people lying in front of shops at night, waiting for the doors to open, to be the first to lay their hands on the latest Google Glass? Rosy predictions about the market notwithstanding (like those of research firms TMR and Visiongain), it is a real question whether the consumer will be prepared to queue in front of the shop for hours for every new gadget, as we see nowadays in the case of a new iPhone.

Launching a sought-after device at the right moment requires a delicate touch, judging by the series of "near thing" devices that might have been successful, but failed to find a way to the public at large. The collection below illustrates that many attempts have been made to develop new products. In its own way, each one of them managed to stretch or inform our expectations as to what is possible and useful.

The BlueTooth headset – The BlueTooth headset, introduced as the communication tool for the business market, disappeared rather rapidly in many countries. The business user continued to appreciate its value a bit longer, but when regular handsets with earphones were supplied standard with the mobile phone, the wireless headset on the ear had had its day.

Virtual Reality Headsets – When the digital world (cyberspace) was still experienced as a completely different space, the idea arose of users being immersed in a virtual world (immersion). Via an enormous head-mounted display, at least the size of a crash helmet, one could behold virtuality. Smart motion and position sensors created the illusion of an artificial three-dimensional world in which defined spaces and objects were visualized convincingly through software. The idea caught on in a small circle of technology evangelists and in the world of design, but as a consequence of the enormous hardware, the required computer capacity and other factors, it still has not made it to the mainstream consumer market. Oculus Rift is now having another try.

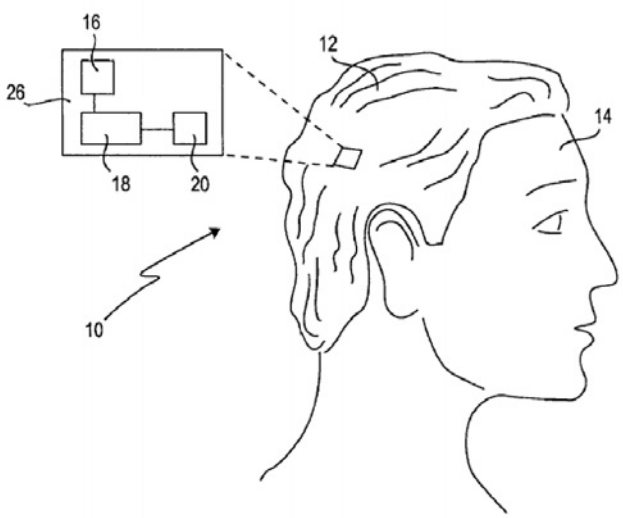
Xybernaut Poma Wearable PC – Although the Xybernaut could still claim an enthusiastic reception at the Consumer Electronics Show 2002, it never lived up to the expectations and the product never made it. The design of this portable PC left much to be desired and the device was very slow to boot. It used Windows CE and cost about $1,500, more than enough to buy a real PC rather than looking ridiculous with a backpack full of peripherals.

Source: http://cdnl.complex.com/m.php/CHANNEL_IMAGES/TECH/2011/04/50-worst-tech-fails/Xybernaut-Poma-Wearable-PC.jpg

The MSN Direct Smartwatch – Judging by the smartwatch introduced by Microsoft as early as 2004, there was never a lack of revolutionary vision. At the time Microsoft introduced SPOT (Smart Personal Objects Technology), a service enabling users to download relevant information (like the weather or exchange rates) with any internet-connected device. The first generation of watches came from Fossil, Tissot and Swatch, but the hardware did not catch on. The internet smartphone became more attractive to the consumer. Another thing was that SPOT cost $60 a month, a price that could not be justified by the limited functionality.

Modo – Launched in 2000, Modo was way ahead of its time. Modo used semaphone networks in cities to transmit local news and information about nearby restaurants and cinemas. The market introduction was successful at first, but due to financial problems of the investors, among other things, it never realized its potential. All the same, Modo was not a complete failure, for the software was later used in Apple's first iPod.

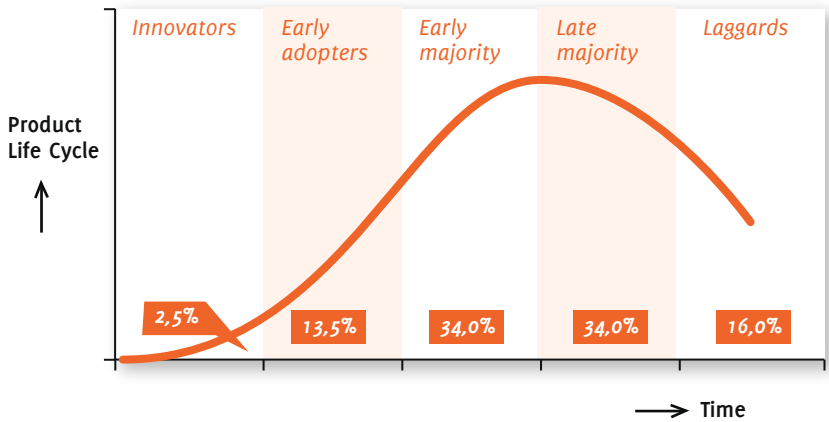
The Smart Wig – The smart wig by Sony is not on the market yet, but already it is termed "even more absurd than Google Glass" and "the most bizarre tech-idea of the year" by some. In October 2013 Sony took out a patent on a number of technologies to develop a smart wig. For those already wearing a wig, the step to this technotoupee might be an easy one to make. Sensors under the wig start to vibrate when a new e-mail is coming in and they can also indicate which way the wearer has to walk. Sensors measure body temperature, and sounds can be recorded and played back.



Source: Sony, 2013

4 Empathic Computing Categorized

The question is at what pace these developments will take place. Some hope it will never happen; others can't wait. Basically all innovations have the same curve: innovators, early adopters, late adopters, late majority and laggards. It is a general categorization of users and consumers of products, predicting the pace at which changes will be embraced, which is vital to the eventual success of innovations.



This theory of innovation dates from the 1950s, and was elaborated in detail by the sociologist Everett Rogers in his 1962 book *The Diffusion of Innovations*. Later Geoffrey Moore added an important element to the idea that there are different groups who decide whether a market launch will be successful: when you listen too much to the fanatics at the initial stage of a market introduction, you will be disappointed. The innovators and the visionaries who mark the early success hardly ever see their predictions of rapid success fulfilled. The fact is that 86% of the users (from early adopters to laggards) are motivated by factors unlike what drives the first group. The trick is to bridge the gulf between these groups, and this is the theme of Moore's book, *Crossing the Chasm*.

The enthusiasm about Google Glass, for example, is currently being led by a select group of users who have been carefully selected by Google: the innovators. Already visionaries are working on prototypes for use in hospitals (the early adopters). But before Google Glass actually changes the streetscape, it must appeal to the early and late majorities and the laggards bringing up the rear. For them, matters such as "fashion," social acceptance, battery life, user-friendliness and "what's in it for me?" are important.

Initial phase	Mainstream
Costs relatively unimportant	Costs play decisive role
User-friendliness of minor importance	Simplicity of use a success factor
The will to familiarize oneself with	The pursuit of efficiency & effectiveness technology

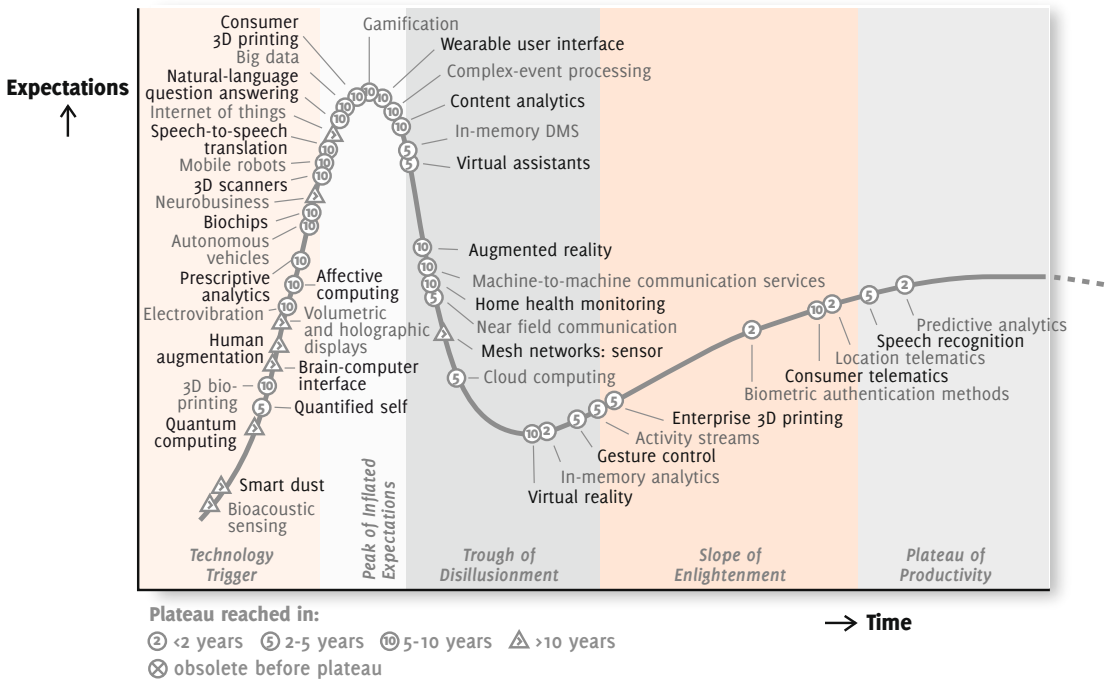
Presumably, the age of Empathic Computing will look entirely different in the dreams of Tim Cannon and other biohackers, or the first people who may be granted the privilege of wearing a digital wig. What the deciding factor is going to be in the eventual application and pace of these developments will be in the hands of those who can cross the chasm between the technological opportunities and the deeper needs of the majority of the population, navigating the complex web of social desirabilities and economic feasibilities of this new technology. It is against this background that we are mapping this new era. The direction is indisputable; the pace, and the ultimate form it is going to take, are less certain.

The symbiosis of man and machine

Man and machine have an interesting relationship, which involves all kinds of feelings: awe, admiration, frustration, boredom, entertainment, indeed even love and hate. Yet we hardly allow ourselves time to reflect on this relationship. We regard our technology as a useful aid for mankind. At the same time, it has always been man who was forced to pander to the whims of technology or technological opportunities: via green screens with commands to icons and mouse, digital forms and applications with complicated process steps and navigation. We have now landed in an age when technology has increasingly acquired the capacity to model itself on man. In this light it is only right to reconsider the relationship between man and machine: what would the ideal symbiosis look like? Can we think of systems that sense what we need and can work for us with hardly any guidance?

The Gartner research firm endorses the trend toward a more intimate man-technology relationship in their Hype Cycle for Emerging Technologies of August 2013. The key message is that the rise of new technologies will redefine the evolving relationship between man and machine. At the same time, the role of technology shapes who we are as human beings, or aim to be. Or, in the striking words used by Marshall McLuhan to describe this symbiotic relationship: *"We shape our tools and thereafter our tools shape us"*. The conclusion is that the borderline between man and machine is fading. McLuhan considers any form of technology to be an extension of a specific human attribute, of physical as well as mental qualities. He regarded a wheel as an extension of the foot, a book as an extension of the eye, clothing as an extension of the skin and electricity as an extension of our nervous system. The way we look at ourselves and the world around us changes the moment these technologies are put to use. Our way of thinking will be different, as will our behavior – not only technology is in transition, but so is man himself. These improvements to our senses come into being due to a closer relationship and co-operation between man and his tools.

From that perspective it is not surprising that former Forrester analyst Sarah Rotman Epps – in the article "Sensors, Sensors, Everywhere: Will They Keep Us From Seeing For Ourselves?" – argues in favor of wearables and embedded devices that do not completely take over our cognitive experiences, but rather improve them. Epps, who now works for Facebook as a Product Marketing Manager for Ad Product Privacy, says that we should promote the use of sensor devices to improve our cognitive experiences instead of outsourcing these experiences. As did McLuhan, Epps ascribes superpower to technology, longing for a time when it will enable humans to bend the world to their will.



Hype cycle for emerging technologies 2013, Gartner

From "kanny" to "psychic pizza"

Sometimes a special terminology is used with respect to the superpowers Epps is referring to. Young people in Finland used to use the pet name "*kanny*" (loosely translated as the palm of the hand) for their NOKIA mobile. People sometimes hold the palm of a hand behind the ear to hear better. But with a mobile phone in our hand, the palm of that hand is becoming a super-amplifier. Evidently young people saw their device as an extension and inseparable part of the body. But how far can we go with this superpower?

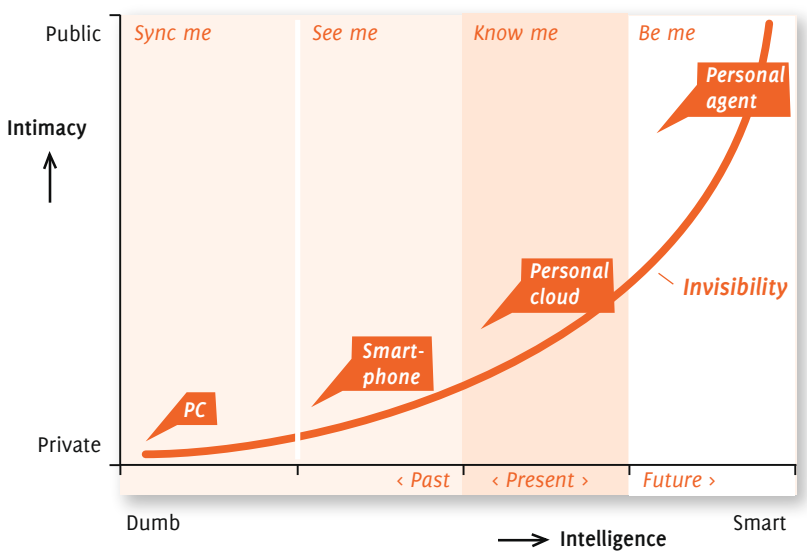
Five years ago, John Goodman from Tarp Worldwide introduced the psychic pizza concept, to indicate that the future of marketing is in anticipating the consumer's wishes. The very moment that the thought occurs to you that it might be a good idea to order a pizza, the pizza delivery boy rings at your door. What's more, he is even delivering the right pizza. The psychic pizza is a metaphor for technology that is becoming increasingly intuitive. Our needs are anticipated before we have started pushing buttons or giving explicit instructions. "Directly from a thought to a pizza delivery" will possibly remain science fiction, or the fear-mongering of people who fear that we will lose control over the new IT systems. Nevertheless, if we persist we will make a major step; after all, technology is coming closer and is sometimes even under our skin, so that our bodies are constantly connected with the internet. The network will gather more and more data from and about individuals and their environments. Intelligent software will transform this data into new insights that will be used in real time to provide services tailored to the customer. In such a situation the user will no longer take the initiative to find useful information or to take action, but relevant information will present itself to the user "automatically" and at exactly the right moment. Your pizza, sir!

The body as interface

Increasingly, our own body will become the interface that communicates directly with the device or any other thing at our disposal. In this way, man comes to occupy center stage to a far higher extent than before, literally and figuratively. We perceive our environment with our senses: we hear cars approaching from far away, smell the autumn leaves in a wood and track pain signals in our body to detect oncoming ailments. Thanks to technology we are able to intensify those perceptions, to become the superpowers we have just referred to. Technological aids such as Google Glass or pedometers like the Fitbit interpret the data supplied by our body and give us feedback. Google Glass tells you where you are (where your body is) and what you are looking at (what your eyes are focused on), and the Fitbit will tell you whether you have done sufficient walking for the day.

If the body itself becomes a more and more important interface and technology is increasingly able to empathize with us humans and what we aim at, then maybe the image of man will change at the same time. The image of man is made up of all assumptions and opinions of what people are by nature, the way they are living in their social and material habitat and the values and objectives they embrace.

Research firm Gartner expects this humanization of technology to take place in actual fact. In November 2013 Gartner announced that in 2017 smartphones would be smarter than their owners: "By 2017 mobile phones will be smarter than people not because of an intrinsic intelligence, but because the cloud and the data stored in the cloud will provide them with the computational ability to make sense of the information they have so they appear smart." "Cognizant computing" is the grand name Gartner uses in this context. It is the next step in personal cloud computing. To reach the dot on the horizon, some four phases need to be passed through. The first two (Sync Me and See Me) have been started off. The next phase (Know Me) is currently taking shape and the last one (Be Me) lies in the near future.



Source: VINT, 2014

From Systems of Engagement to Empathic Computing

What is needed to realize this hyperpersonalization and contextualization in order for organizations to create new, exciting, eye-catching, positive customer experiences? Developments are taking place on both the hardware and the software fronts. The network-connected systems, at the back of all "things", are increasingly functioning like an electronic brain, such as the personal and smart technologies of IBM's Watson, Apple's Siri and Google Now. They are increasingly capable of making connections and associations autonomously. In the book *Smarter Than You Think* (2013), Clive Thompson discusses the "Ambient Awareness" concept. In his view, we are developing a kind of digital antennae by means of our social media, and they tell us whether a person feels good or not, for example. As a matter of fact there is already information hidden in our online data that tells us something about our spiritual well-being.

It turns out that by combining all the available information, more pointed conclusions can be drawn as to an individual's current and future behavior. Thus a digital representation of the individual emerges: by making smart use of all kinds of social data, such as tweets, Facebook status updates and Instagram photos, but also the geolocation, the air humidity and even the heart rate and body temperature. Reading out the facial expression or ring of a voice could add an emotional layer to information. Not only does this enable the network to empathize and sympathize with the individual, but also to sense what kind of support the individual needs at that specific moment. What's more, the network will probably be able to predict the individual's intentions even before he is aware of them himself. Analyzing the personal digital context allows a network to empathize entirely with the individual.

A private digital aid for all

The idea of technology advising and assisting people like any other "best friend" returns in Apple's Siri. This iPhone application is based on Corporal Radar O'Reilly from the popular TV series M*A*S*H. Colonel Sherman Potter's amusing aide lived up to his name, for he had superhuman powers of observation and intuition. He was already at Potter's side even before the man had the chance to call him. Similarly, he finished other people's sentences all the time and had very acute hearing: Radar heard helicopters approaching long before others became aware of them.

The American DARPA (Defense Advanced Research Projects Agency) saw the Army's future in this TV character, for in digital form he would be the ideal assistant of any soldier. DARPA realized this vision in conjunction with SRI International, the commercial research branch of Stanford University, thus giving birth to Project CALO, a Cognitive Assistant that Learns and Organizes.

At the end of the day, the research resulted in the famous Apple application Siri, which we put to work for us in normal spoken language. Siri, our digital assistant, is standing by, to serve in all sorts of ways. For example: "Siri, would you book us a table in an Italian restaurant for tonight, please". On the basis of your geolocation, personal preferences and budget, Siri will arrange the booking instantly. In February 2010 the

free app was launched in the Apple AppStore, and on April 28th of the same year Siri was sold to Apple. Soon after the merger, Curt Carlson, President and CEO of SRI International, commented on the impact of Virtual Personal Assistants on our lives:

> *"You can guess what will be in the next iPhone. This technology could be as ubiquitous as the PC-mouse user interface that was created by Doug Engelbart here more than 40 years ago."*

Meanwhile Google Now, Google's answer to Apple's Siri, is capable of listening in constantly, without you being aware of it. By means of a simple spoken command ("OK Google"), this digital aid on your Android phone is activated and gets to work for you right away. "Talk to me" is the latest "click here". Any question put to such a device is answered super-fast via the cloud, by applying the latest neural network technology. Microsoft demonstrated an application that not only transcribed a speech in English simultaneously into Mandarin, but – what's more – the same speech was recited in real time in Mandarin, in the voice of the speaker!

Technology is becoming invisible: from GUI to NUI

The British science fiction writer Arthur C. Clarke said: *"Any sufficiently advanced technology is indistinguishable from magic."* The fact that currently all sorts of technology – in the form of sensors – are placed on or even beneath the skin of the human body enables the physical and digital environment to react instantly to man's natural interface. The natural user interface (NUI) takes over from the traditional graphical user interface (GUI). Sensors that perceive gestures and recognize emotions, that listen to what you are saying, that feel how you touch them, and can even smell, will eventually ensure that a keyboard or mouse is no longer needed to interact with the network. As a result, technology is moving into the background definitively, to continue its work from there unseen. Consequently, the borderline between man and technology is fading, possibly causing a situation where man can no longer do without technology. Technology and man will fuse, as it were.

In the movie *Her* the main character develops a relationship with an intelligent computer that, literally and figuratively, meets all his desires. *Wired* magazine has already called this movie the new *Minority Report. Her* demonstrates the future of the user interface: how invisible technology will support and enhance our abilities; in other words, how Empathic Computing will change our lives.

Empathic systems will turn us into cloud people

This fusion is less remote than it may seem. We are witnessing the advent of a flexible, scalable, invisible computer network that we will control in the long run via natural interfaces that are in direct contact with our senses. Self-learning algorithms ensure that this intelligent network is increasingly capable of making observations autonomously so as to anticipate the individual's emotions and intentions proactively. As we have seen in the case of GPS, we rely on technology that is useful, easy and cheap, and

this we do without any problem. Before long we will find it hard to do without this digital aid; the network will become our prop and stay: technology as a prosthesis for the brain. This dependence will turn us all into "cloud people". It is a kind of development that has been predicted for a while, albeit in slightly less magical terms. Below you will find a small historical lexicon of earlier predictions of what this digitalized world might look like in due course.

Terminology for an increasingly digital world

Pictures of the future on the basis of ubiquitous computer power and smart interaction have existed for a very long time. Concepts such as *smart tech* or *smart cities*, and various terms including the word *ambient* have been used to describe all sorts of visionary developments over the last few decades. The terms we often come across are the following:

Ubiquitous computing – Mark Weiser, Chief Scientist of Xerox PARC was way ahead of his time in 1988 when he introduced this concept about the dissemination of computer power: always and everywhere, in any device or size, at any location. This vision emerged when smaller, more powerful and reliable network processors became available. Weiser foresaw the mobile revolution. At an early stage he referred to Tabs (small), Pads (handheld) and Boards (TV-sized), all the different devices we consider normal nowadays.

Ambient or Pervasive intelligence – A futuristic vision of a physical environment equipped with all kinds of electronics and telecommunication facilities that detect the presence of humans and react to them. The central idea is that, as a consequence of the advancing miniaturization of the technology, the increasing computing power and the far-reaching integration with the environment, the technology is entirely fading into the background and becoming invisible to the users, hidden behind a practical, non-technical interface.

Perceptual computing – The idea that our interaction with devices is assuming a more natural form, more intuitive as well as more "immersive," in other words, that we are completely absorbed by it. Elements of such interaction are gestures, speech recognition, facial tracking and recognition, and the integration of all these interactions. The concept was reanimated the other day by Intel.

Wearable computing – By the late 70s MIT pioneer Steve Mann was making electronic systems that were worn on the body. What started as an impressive rack on Mann's back is now a pair of glasses with WiFi. In all likelihood, there would have been no Google Glass without Steve Mann. Incidentally, Mann currently is a consultant with Google, with a view to their development.

Cognitive computing – This is the vision of the future of IBM and others, where the computer is placed at a higher level within the familiar Data-Information-Knowledge-Wisdom hierarchy, the level of *knowledge* processing. This new level demands that computers build up an understanding of the world around us, develop the ability to perceive that environment autonomously and derive meanings from it. Such powers of observation or "consciousness" can only be realized if – like humans – the computer has its own senses at its disposal. IBM, for one, goes for the development of digital smell, taste, touch, vision and hearing by machines.

5 Empathic Computing in Business

When it comes to large-scale applications and the business impact of technology, we need to look at the combination of technological possibility, social receptivity and economic feasibility. These three factors decide whether empathic systems will eventually be part of the value chains of organizations and our lives. It is all about adoption by the public at large, not only enthusiastic innovators or early adopters.

To prevent "things" from ending up as gadgets in a kitchen drawer, they should help us save time, energy and money, capitalize on opportunities, etc. It is applications that ensure that we are more effective and can be more efficient in our spare time or our active lives, that will indeed have a business impact. In our first Things study we already introduced the theme "waste" as a reference point for sustainable innovations.

The problem is, however, that most organizations are still busy adapting to the information-oriented behavior that was introduced earlier with the smartphone and social media. And now the question presents itself, how can a significant business impact be generated with the next phase of empathic systems. This time, however, the increase in mobility is not an outcome or conclusion, but a driving force. In any event, it is important to realize that the applications are not reversing the trend of the past, but are a clear signal that the future is in more personalized and empathic systems. Without going into too much detail with regard to the applications in various economic sectors, we look at the question of what might change due to the rise of even more forms of Empathic Computing.

The low-hanging fruit

If a pedometer can ensure that employees live healthier lives, this makes a difference in terms of the cost of illness-related absenteeism. Or if you can make better predictions as to what a customer needs on the basis of impressions from Google Glass, you can sell more. If the security in an office, factory or system can be enhanced by making employees swallow a password pill, it decreases risks. If patients take their medication according to schedule, or if technology sends out an alert warning for possible medical problems before they actually take place, it decreases health-related costs. In all kinds of scenarios more information can help to improve operational processes. If an airline company can accelerate its process of loading and unloading by adjusting the movements and interactions of the people on the platform in real time, millions can be saved. By and large, quick profits can usually be made by optimizing processes: reducing "waste" by making better use of people, products, resources and time. Then the more complex but potentially far more profitable initiatives in the fields of communication and customer interaction will follow.

Context is king

In this digital world we are flooded with impressions, news and interruptions. We live in an attention economy where "attention" is the most valuable commodity. If the customer pays attention, this interaction should of course leave behind a positive

feeling and be regarded as valuable. Only then will the customer return, and hopefully buy more products or services.

Context is the key concept: understanding and responding to the mindset of the customer (or employee). Understanding when a customer is most likely to be receptive to an interruption, and what kind of interruption will be experienced as the most valuable at that particular moment. For if there is one thing that enables all this personal and intelligent technology, it is better insight into the user and his intentions. All sensors contribute to a rich context, and together lay the foundation of a new phase of personalization and intelligence. The list of sensors on Wikipedia (http://en.wikipedia.org/wiki/List_of_sensors) gives a good idea of the enormous variety of available sensors that contribute to understanding and gaining insight into the context of a user. In a way, the computer can experience what you experience.

This is the crux: the old marketing lesson of product-price-place-promotion still holds good, but "place" has been replaced by "context": we want to offer our services, solutions, message and interaction in the context that the receiver prefers. And the ultimate context is the context as the customer experiences it himself. By speaking about empathy, we aim to enable the systems to draw up hypotheses – in the context we know, together with everything we know about the individual – about what the effect of the context will be on the customer, the user, in order to define an appropriate response.

The new Bring Your Own Device

On the basis of predicted sales figures of all kinds of wearable computing devices, it may be expected that the adoption of Empathic Things will become part of the BYOD policy in organizations. Within five years, devices such as Google Glass, the Pebble, the Fitbit Flex and in all probability the Apple iWatch will be widely accepted in the workplace. As in what happened when the smartphone and the tablet were introduced, employees will buy these devices themselves and expect that their organizations will encourage them to use them – simply because they use these devices to do their work. Wearables accelerate the need of a flexible BYOD strategy in organizations. From BYOD to BYOWD. Some, for that matter, call it Wear Your Own Device (WYOD) instead of Bring Your Own Wearable Device. In short: the "consumerization of IT" has by no means had its day.

The study *The Wearable Computing Market: A Global Analysis* by GigaOm, underlines the importance of wearable computing for specific kinds of work. Particularly in the case of repairs and maintenance of heavy infrastructure (e.g., nuclear reactors and advanced hardware), or in the building industry, where real-time geographical information is required, wearables are just what is needed:

> *"The enterprise environment will play an important role in the growth of wearable computing because of the hands-free nature of the work. In contexts such as hardware repair, maintenance of heavy infrastructure (e.g., nuclear reactors and sophisticated hardware) or outdoor construction, where real-time geographical information is required, wearables can be ideal."*

Systems of Engagement thanks to Empathic Computing

The advent of Empathic Computing results in an extra realtime dataflow. Here knowledge is no longer something that is saved in databases, but is instead a constant flow of information that employees have to immerse themselves in. The days are gone when knowledge was regarded as a static power; it should expressly be seen as a force, as leverage. In the past we used to regard information technology as a way to process data. All the time the focus in organizations was on optimizing these databases. Thanks to Facebook and Twitter, there is a shift taking place in organizations nowadays from these so-called Systems of Record to the Systems of Engagement, the focus being on communications with and between people – a shift that is endorsed by Forrester in their study *Mobile is the New Face of Engagement*, by IBM, which even established a "Systems of Engagement Info Center," and by Geoffrey Moore, who published the study *Systems of Engagement and The Future of Enterprise IT: A Sea Change in Enterprise IT* in 2011.

Nowadays the interaction with the customer takes place via these Systems of Engagement, which are actually becoming more and more "engaging": interactive websites, apps, voice-response systems and so on. But the employee and the customer are unable to constantly enter into conversations and absorb all this information. They are increasingly dependent on the extent to which technology manages to offer client-related solutions. Empathic Computing provides the ingredients to make these Systems of Engagement work, as they are fully capable of empathizing with the individual. This is in fact happening right now. Technology is increasingly assuming the form of a virtual assistant who supports the user 24/7 and serves the user hand and foot. Google Now, for example, keeps employees automatically up to date with regard to their appointments, their duties and the fact that queues are likely on their routes. Thanks to Google Glass, the car mechanic too can see exactly how a particular engine works, and a surgeon can film an operation in real time and share it with assistants. And what about the employee who is walking through a workshop and feels how his wristband starts to vibrate because a nearby machine has some sort of defect. Thus the Systems of Engagement, which are particularly characterized by interaction, are complemented by systems that understand what we need and respond proactively.

The major insights into developments started off by Empathic Computing:

- Empathic Things continue the shift in our way of thinking from products to services. Services are created in systems, not in devices.
- Empathic Things intensify and extend the relationship with customers; they are going further ahead with personalization and hypertargeting.
- Empathic Things give the physical world antennae, which results in new insights into how the world works and can function better.

6 Seven Foreseeable Truths

If the idea of Empathic Computing will take on a wide scope, as large numbers of futurists, visionaries and analysts assume, what will the future look like? Bearing in mind the trends and developments in technology, we venture to mention some possibilities. Taken together, they present a picture of a future in which the digital and physical worlds become increasingly closely interwoven, with a central role for the symbiosis between man and information network. That symbiosis can make our lives more comfortable, give us superpowers and possibly make us healthier. But before pedometers and stress meters become standard devices aiming to keep spiraling health-care-related costs under control, we need to be aware that – as we go along – we will inevitably restrict personal freedoms, necessitating new legal frameworks for our health insurers and care providers.

1. **Never before was life so simple**
   If a world comes into being where personal, intelligent and anticipatory technology is acting in our interests like a ubiquitous entity in the background, life will be simpler than ever before. Information systems that adapt themselves at a personal level save us the time that it takes to find the right information and to make all sorts of trivial choices; similarly, they remove concerns by keeping an eye on matters that we feel are important. Self-regulating processes require no human intervention. And if technology is so close to the skin, we know all about ourselves and our environments and will never again be faced with unpleasant surprises.
2. **People will have superpowers**
   Technology helps us go beyond our human limitations. We can intensify our existing senses or even add completely new senses to our human stock. What started in the medical world for people with disabilities is rapidly spreading to the entire population. Will there be new generations of people who no longer have the biological limitations of the human body? The opportunities offered by technology in, on and around us are countless, which may imply that in the long run ethical scruples will be overshadowed by the wish to make the most of the opportunities.
3. **The body is the new password**
   We use several passwords every day, but how safe are they? More often than not, passwords can be retrieved relatively easily; or even worse, people use one and the same password for different online services. The complexity of logging in on a digital environment fades entirely into the background by employing Empathic Things. What comes to mind, for example, is the password pill by Motorola that we referred to earlier. Swallow one pill once a day and the digital world responds to you; or even better, have one implanted in your body, and you're set for life.
4. **The "quantified employee" is the employee of the future**
   Hyper measurability is extending its ability to measure anything, and now extends to the shop floor: from the relationship between the amount of coffee consumed and the production capacity, to the connection between the minimum physical activity per employee and health-related costs. Bring Your Own Wearable Device

(BYOWD) will be generally accepted, provided the data is used to maximize the benefits in every respect. Logistic processes, social processes and communication within the organization can be analyzed and optimized to any required level.

5. **The shift in health care from cure to prevention**
   From people who cure, doctors are becoming people who prevent. Diseases, symptoms and all sorts of ailments are detected long before they actually become a problem, as revealed by sensors and data-analytical models. Values are adjusted and treatments performed by means of remote-controlled technology inside the body, thus minimizing the chances of premature death. Wherever possible, biological remedies will be applied, and in all other cases mechanical alternatives on a nano-scale will be employed. Health insurers will look at the individual's risk behavior and adjust their premiums accordingly; this, in its turn, will result in healthier and safer behavior.
6. **Products will judge whether you are a desirable customer**
   Products know the customers' intentions and behavior so well that, in due course, they will assess whether they want you as a customer. In the case of driving behavior, we can imagine that this might work. Car insurers who disqualify young people from driving at night (in connection with alcohol abuse by young drivers) could keep tabs as to how late the car is used. Car2Go, a service renting out electrical cars, does the same with regard to motoring performance, and reserves the right to cancel subscriptions. Similarly, pedometers and measuring instruments for the human body could well become the first aid for health insurers when it comes to providing or refusing coverage.
7. **Empathic Computing as a new goldmine for espionage**
   The sum of quantified people, objects and environments is a quantified, digital society. Not only within the borders of the virtual, but far outside in a new reality where the digital is closely interwoven with the physical. New parties – whether they are state authorities, hackers or terrorists – will use and abuse this kind of datafication and attempt to bend this digital infrastructure to their will, or at least to disorganize it. To prevent this, the digital layer encompassing the physical society will be subjected to intense monitoring, much as the web was already monitored on a permanent basis. Every bit of information will be scanned and analyzed by third parties, and if smart algorithms find it necessary, alarm bells will go off so possible danger is prevented.

7 The Great Paradox of Empathic Things

An enormous paradox is concealed in the new possibilities that Empathic Things offer to us. After all, the word "empathy" suggests that computers empathize with our existence and supply those things that serve us best. But if the result of all those devices is that our digital activities will only increase and divert our thoughts, is that what we really want? If these devices are truly empathic, shouldn't they dissuade us from even more virtual activity? And if they did do just that, for example with a stop button on our internet connection, we may well regard that as a restriction of our freedom and a sign that "the computers are taking over"?

It certainly sounds good: always switched on, close to the skin, connected with systems and others. But it is this very kind of new opportunity that implies risks – for our privacy, for example. The systems cannot possibly become more empathic if we do not give up more of our privacy. Some say that, as far as they are concerned, that really is not necessary, and that the bounds of privacy were exceeded a long time ago. But who really decides that enough is enough and discards Google, or throws away customer loyalty cards, knowing that it means no rewards bargains and handy search functions? We are all faced with this paradox of Empathic Computing. It is a confrontation between our own behavior and choices, with sacrifices that we are generally prepared to make. In fact, society is engaged in one big experiment of exploring how people, individually and collectively, react to stimuli and information 24 hours a day. Due to the self-cleaning capacity of many social media, for example, we live in a filter bubble where the stimuli are increasingly geared to our preferences. Will our empathy vis-à-vis one another decrease due to that empathic computer? Is that what is awaiting empathic systems, or will mankind regain control instead?

The big questions

The last word has not been said about how Things will influence our behavior, but it is clear that we need to reflect on this before we are caught by surprise by the next wave of gadgets and applications. If we wish to serve people better with empathic systems, organizations need to make choices that contribute to the course that we, as a society, will take. The big questions that can help us govern the discussion, and hence the future, are in the following spheres:

Privacy – Of course data privacy is an issue. What happens to our sleep and activity data? They are on the server of an American supplier, obviously, and judging by the latest revelations, it is by no means certain how safe that data is. An insurer, for example, might be very interested in a patient's health record: will self-measuring become compulsory in due course to reduce health-related costs? In such a case, a wristband can easily be seen as a handcuff.

Control – Directly related to this is the big question of who can control personal data that is now saved somewhere in the cloud. Shall I, as an individual, have control of my own data, or will all kinds of organizations sneak off with it? In his book *The Intention Economy*, Doc Searls sketches a future where every individual decides for him- or herself who will or will not get access to that data. Searls assumes that in the future businesses will be prepared to pay people compensation in order to get access to this data, with a view to serving the customer hand and foot. Data ownership has been a theme in the regular internet debate for a while, but with personal data about where you were and what you were doing at any moment of the day or night, this discussion is really made all the more fascinating.

Compulsive behavior – Do we still have a "healthy" relationship with our phone, or is it a matter of increasing compulsiveness to the point that the phone is predominant over everything else? Larry Rosen, a professor at California State University and an expert in the field of the psychology of technology, is very clear on the subject. He says: *"In our studies, the typical teen and young adult checks his or her smartphone every 15 minutes or less and if they can't check as often as they like, they get anxious. This anxiety then drives the need to check in to reduce the anxiety which then begins to build again."* Needless to say, he expects that the adoption of these new devices will only serve to enhance this compulsive behavior.

Donald Norman, author of the books *The Invisible Computer: Why Good Products Can Fail, The Personal Computer Is So Complex*, and *Information Appliances Are the Solution* arrives at a comparable conclusion. In his more recent article "The Paradox of Wearable Technologies," he seeks a balance between the pros and cons of all these new technologies. On the one hand, all these connected and smart devices can strengthen mankind, but on the other, they will be counterproductive as they demand even more attention on our part. Norman is wondering if this continuous stream of news will prove to be an irresistible and permanent source of diversion, or that the opposite will happen and it will improve our skills. Vint Cerf, the internet pioneer currently active with Google, also has doubts about these new technological developments. He openly wonders if our social conventions are at all capable of keeping abreast with the pace of technological developments. Scott Heiferman, founder of Meetup.com, stirs the pot by regarding anyone wearing the Google Glass as an asocial individual:

> *"It basically means that you're going to be an asshole, and that it's easier and easier to ignore people around you."*

Social acceptance – Wearable computing ensures that we are always online. There is no longer a difference between online and offline. Nowadays we are still perfectly aware when someone finds himself in the digital world, because he is gazing into the screen of his tablet or smartphone. In the world of Google Glass this is far less evident. Is the wearer of the glasses looking at me and am I having his undivided

attention, or is he secretly reading his mail and only pretending to look at me? It is not surprising, therefore, that a counter movement has emerged, “Stop The Cyborgs,” that is promoting a ban on the use of Google Glass in public places. The members of the movement are extremely concerned about the effects that Google Glass will have on our society. As yet, no one has the answer to the question how socially acceptable these devices are. However, Google Glass is only the beginning. Narrative clip, for example, is a wearable 5 megapixel camera that you clip on the collar of your shirt; it takes a photo every 30 seconds. Each photo is automatically given a timestamp and a geo-location. At the end of the day all photos can be easily uploaded to the Narrative clip cloud and you can subsequently have a look at the pictures at any place and any time.

8 Conclusion and Six Business To-dos

In conclusion, we repeat the three main conclusions and provide six "business to-dos" that are recommended in order to make the most of the potential of Empathic Things.

Conclusion 1: It is an evolution, not a revolution

Empathic Computing is a next step in a longer evolutionary development and not a revolution, even though the impact on our information society in the foreseeable future could be spectacular. Indeed, that computers are becoming more and more personal and getting closer to people's skin is something that has been going on for much longer: from mainframe computer to desktop, smartphone, Google Glass, digital tattoos to smart tech pills. The information society is becoming more and more personal, and the empathic capacities of devices and systems are increasing all the time, thanks to sensors, actuators and other elements of the Internet of Things.

Conclusion 2: Context is king, empathy the norm

Whoever regards Twitter and Facebook as gadgets and an annoying interruption of what "real" IT is all about, is in for a surprise. Empathic Things are inescapable. In, on and around the body, they support us in the interaction with systems and the environment. In combination with other Connected Things, ecosystems emerge of increasingly smart systems that help us proactively. In order for a system to really be loved, it must be able to show empathy. Not in the sense of a vague, undefined feeling; on the contrary, it must be capable of concrete assessments of what the customer, user or employee needs at any specific moment: entering into a dialogue, whether or not via data of the body that acts as an interface. In such a case, a valuable interaction is offered from a rich context, and once again via things, enchanted objects or perhaps simply via our laptops or tablets. We may be referring to empathy, but in fact we are talking about humans and their motivations. The same is true of empathic systems, but similarly of the ethical questions around Things, biohackables, privacy and compulsive information behavior.

Conclusion 3: Finding a balance between empathic and emotional

Perhaps the main conclusion must be that we have started a great sociological experiment whose outcome is as yet unknown. In the years to come we will be faced with new questions and new appraisals – through the technological possibilities – to which we will have to find answers. Take Google Glass, to begin with. It may come in handy in an OR, but in a classroom or bar it can easily be a distraction or worse. It is often difficult to distinguish between what is handy and smart, and what goes beyond the pale. When an employer monitors bus drivers for deviant behavior by means of "seeing machines," this may be a sensitive "emotional" issue in the eyes of the drivers, but in the eyes of the passengers such an empathic system may simply be a matter of increased safety. If health-care insurers can reduce care-related expenses by means of Empathic Computing, it is a solution to a huge problem. On the other hand, it invites

emotional response when we refer to such a society as one that excludes people on the basis of an unhealthy lifestyle, in combination with technology that monitors us on a permanent basis. At the end of the day, our future is defined by the sum of what is socially advisable, economically feasible and technologically possible. This is not only true of the individual choices we make, but also of the great social issues.

Six Business To-dos

The story of Empathic Things is currently characterized on the one hand by uncertainty as to the question to what extent products such as Google Glass will be successful, and the inherent magical potential of innovative applications on the other. In this study we have referred to them as the seven foreseeable truths, the scenarios for the future. The short scenarios that we presented are:

1. Never before was life so simple.
2. People will have superpowers.
3. The body is the password.
4. The "quantified employee" is the employee of the future.
5. From cure to prevention in health care.
6. Products will judge whether you are a desirable customer.
7. Empathic things as the new goldmine for espionage.

As is true of any form of technology, here too each organization and line of business will have to make a comparative assessment, and "foreseeable truths" are by no means absolute certainties. In this context we have identified six "business to-dos" that have allowed for these potential scenarios.

- **Digital first**
  Empathic Things add a new digital layer to business practice. This opens new avenues in terms of commitment toward customers, employees and partners in digital ecosystems. New consumer data open up vistas of new sales opportunities. Gartner expects that in 2020 consumer data from wearable things will feed as much as 5% of the sales among the biggest businesses. That data is particularly interesting to advertisers, because it is even more personal than consumers' web behavior; advertisements can be made even more customer-oriented, with prospects of higher conversion to sales.
- **Build Systems of Engagement**
  Static IT-systems are things of the past – dynamic and empathic systems are the future. It should be noted that the value is hardly created in the devices themselves, but in the ecosystem of which the devices are a part. When someone wears an activity tracker, the real value becomes manifest in the application that provides insight into the data. It is the open character of the programming interface (the API) to which the service can be linked that decides whether the data can be shared in relevant communities.
- **Analyze where connectivity can be a contributing factor**
  The unique strength of Empathic Computing and Things will not be realized until

it adds connectivity where it was hitherto impossible. A forklift driver cannot possibly have a laptop on his lap all the time. But digital glasses that give access to the right kind of information add connectivity in a situation where that was previously impossible. And consider gaps in the information known about employees. Where can real time connections with information add value and contribute to the work someone is doing, if only to make things easier or more efficient? Value is determined by the extent to which the information links up with and responds to the user's context.

- **Build better "knowledge bases"**
  Data must be provided with the right metadata to be used in the user's context. The richer the data points, the better they can be opened up at the right moment and in the right way. Data points such as identity, location and history are obvious, but before long temperature, weather, humidity, haptic feedback to stimuli, facial expression and emotions will equally be stored as data points, collected with the help of different sensors.
- **Build bridges between early adopters and mainstream users**
  In all likelihood there are early adopters of all kinds of activity trackers: for example, in your environment. Invite them to a pilot project in which you enable colleagues to share activity data or stress data in a social ecosystem. What new views can you gain from this with regard to the health of employees, and what are the effects if you openly share this kind of data? You may discover, for example, what busy "junctions" there are in your office with the help of location data, or at what times of day the highest degree of stress is experienced. Also, buy some specific Empathic Things that support your business goals, and ask your employees to use them in their practice and to share their views with colleagues. To be really successful, you need to realize that the vast majority of your staff will be less interested than the early adopters and innovators. To bridge the gap between these two groups and reach many more people, you should not gear your plans to the latter party more than is necessary.
- **Ensure sound privacy**
  With technology so close to the skin, data has never been so personal, and consequently privacy has never been so vital. For that reason it is a good thing to make clear what happens to data gathered in pilot projects or other applications, and to let those involved have control of their own data. Make privacy part of the design. It is important that the exchange is clear: what reason is there for users share their data?

Literature and Illustrations

ABI Research (2013): 'Wearable Computing Technologies'

Anders, C.J. (2009): 'How can you tell if you are suffering from Future Shock?', io9, http://io9.com/5981514/how-can-you-tell-if-someone-you-love-is-suffering-from-future-shock

Anthes, E. (2013): 'Frankenstein's Cat – Cuddling Up to Biotech's Brave New Beasts', *Scientific American*

Bilton, N. (2013): 'Disruptions: Where Apple and Dick Tracy May Converge', *The New York Times*, http://bits.blogs.nytimes.com/2013/02/10/disruptions-apple-is-said-to-be-developing-a-curved-glass-smart-watch/

Bilton, N. (2013): 'Why Apple Is Working on an iWatch and Not iGlasses', *The New York Times*, http://bits.blogs.nytimes.com/2013/02/11/why-apple-is-working-on-an-iwatch-and-not-iglasses/

Burrows, P. en A. Satariano (2013): 'Apple Said to Have Team Developing Wristwatch Computer', Bloomberg, http://www.bloomberg.com/news/2013-02-12/apple-said-to-have-team-developing-wristwatch-computer.html

Burrows, P. en O. Kharif (2013): 'Apple's Planned "Watch" Could Be More Profitable Than TV', Bloomberg, http://www.bloomberg.com/news/2013-03-04/apple-s-planned-iwatch-could-be-more-profitable-than-tv.html

Business Insider (2013): 'Wearable Computing: From Fitness Bands to Smart Eyewear, A New Mobile Market Takes Shape'

Carr, N.(2010): 'Does the Internet Make You Dumber?', *Wall Street Journal*, http://online.wsj.com/article/SB10001424052748704025304575284981644790098.html

Credit Suisse (2013): 'The Next Big Thing – Wearables Are In Fashion'

Duivestein, S. (2009): 'Moving into the Age of Realtime', Frankwatching, http://www.frankwatching.com/archive/2009/04/22/26240/

Duivestein, S. (2012): 'The Age of Context komt eraan', Frankwatching, http://www.frankwatching.com/archive/2012/08/04/the-age-of-context-komt-eraan/

Duivestein, S. (2013): 'RoboRoach is neurologie voor iedereen: beheers het brein van een kakkerlak', Frankwatching, http://www.frankwatching.com/archive/2013/06/14/roboroach-is-neurologie-voor-iedereen-controleer-het-brein-van-een-kakkerlak/

Duivestein, S. (2013): 'We Never Lookup Any More', Marketingfacts, http://www.marketingfacts.nl/berichten/we-never-look-up-anymore

Duivestein, S. (2013): 'De Google Glass Zombie'

Duivestein, S. (2013): 'Maakt Google Glass zombies van ons?', http://www.frankwatching.com/archive/2013/05/26/maakt-google-glass-zombies-van-ons/

Duivestein, S. en J. Bloem (2012): 'We the Web: De verovering van het leven op de hectiek', Frankwatching, http://www.frankwatching.com/papers-books/trendrapport-we-the-web/

Duivestein, S. en J. Bloem (2012): 'Apps ook voor apen & wensen wordt werkelijkheid', FrankWatching, http://www.frankwatching.com/archive/2012/03/10/apps-ook-voor-apen-wensen-wordt-werkelijkheid/

Duivestein, S. en J. Bloem (2013): 'Wearable computing: de start van onze YOUniverse', Marketingfacts, http://www.marketingfacts.nl/berichten/wearable-computing-start-van-onze-youniverse

Duivestein, S. en Th. van Manen (2012): 'De Slow Web Beweging: onmiddelijkheid maakt plaats voor gepastheid', Frankwatching, http://www.frankwatching.com/archive/2012/08/14/de-slow-web-beweging-onmiddellijkheid-maakt-plaats-voor-gepastheid/

Evans, J. (2013): 'Is this the Apple iWatch? Patents say it could be..', ComputerWorld, http://blogs.computerworld.com/ios/21800/apple-iwatch-patents-say-it-could-be

Fitchard, K. (2013): 'Forget the Quantified Self, We're Entering the Age of the Quantified Pet', GigaOm, http://gigaom.com/2013/04/14/forget-the-quantified-self-were-entering-the-age-of-the-quantified-pet/

Forbes (2013): 'The Next Big Thing In Enterprise it: Bring Your Own Wearable Tech?', http://www.forbes.com/sites/reuvencohen/2013/08/14/the-next-big-thing-in-enterprise-it-bring-your-own-wearable-tech/

Forrester Research (2012): 'Wearable Computing – The Next Devices And Platforms That Matter To Your Product Strategy'

Garrison, C. (2013): 'We Never Look Up: Tumblr illustrates our tech-dependent society', Metro, http://www.metro.us/newyork/lifestyle/2013/01/07/we-never-look-up-new-tumblr-illustrates-our-tech-dependent-society/

Gartner (2013): 'Market Trends: Enter the Wearable Electronics Market With Products for the Quantified Self'

Gassée, J.-L. (2013): 'The Next Apple TV: iWatch', MondayNote, http://www.mondaynote.com/2013/02/17/the-next-apple-tv-iwatch/

Gelernter, D., 'The End of the Web, Search, and Computer as We Know It', Wired, http://www.wired.com/opinion/2013/02/the-end-of-the-web-computers-and-search-as-we-know-it/

GigaomPro (2012): 'The wearable computing market: a global analysis', http://go.gigaom.com/rs/gigaom/images/wearable-computing-the-next-big-thing-in-tech.pdf

Heather, K. (2013): 'New tech tools help keep Fido fit', CNN, http://edition.cnn.com/2013/06/05/tech/innovation/whistle-dog-tracker

IMS Research (2012): 'World Market for Wearable Technology – A Quantitative Market Assessment – 2012'

Jenkins Jr., H.W. (2011): 'Rethinking the Digital Future', *Wall Street Journal*, http://online.wsj.com/article/SB10001424052970203833104577072162782422558.html

Juniper Research (2013): 'Smart Wireless Accessories – CE, Fitness, Health, Payments & Enterprise 2013-2018'

MIT Technology Review (2013): 'The Paradox of Wearable Technologies', http://www.technologyreview.com/news/517346/the-paradox-of-wearable-technologies/

Munford, M. (2013): 'Dairymaster and MooMonitor milk wearable technology's benefits', *The Telegraph*, http://www.telegraph.co.uk/technology/10262929/Dairymaster-and-MooMonitor-milk-wearable-technologys-benefits.html

Naughton, J. (2013): 'Why a stream of consciousness will kill off websites', *The Guardian*, http://www.guardian.co.uk/technology/2013/feb/10/stream-consciousness-computer-desktop

Rotman Epps, S. (2013): 'Wearable Devices' Next Design Challenge: The Human Brain', ReadWrite, http://readwrite.com/2013/02/04/wearable-devices-next-design-challenge-the-human-brain

Rushkoff, D.s (2013): 'Present Shock: When Everything Happens Now', Current Hardcover

Silicon Angle (2013): 'How Wearable Tech Will Take The Enterprise By Storm : Google Glass, iWatch and Beyond', http://siliconangle.com/blog/2013/08/12/how-wearable-tech-will-take-the-enterprise-by-storm-google-glass-iwatch-and-beyond/

Tognazzini, B. (2013): 'The Apple iWatch',http://asktog.com/atc/apple-iwatch/

Transparency Market Research (2013): 'Wearable Technology Market – Global Scenario, Trends, Industry Analysis, Size, Share And Forecast 2012 – 2018'

Visiongain (2013): 'Global Wearable Technology Market 2013-2018: Smartwatches, Tech Clothing, AR Glasses, mHealth, Fitness & Wellbeing'

Wing Kosner, A. (2013): 'Will Apple's iWatch Usher In A New Time-Based User Interface?', *Forbes*, http://www.forbes.com/sites/anthonykosner/2013/02/19/will-apples-iwatch-usher-in-a-new-time-based-user-interface/

Wing Kosner, A. (2013): 'Douglas Rushkoff's Present Shock: The End Of Time Is Not The End Of The World', *Forbes*, 22 december 2012, http://www.forbes.com/sites/anthonykosner/2012/12/22/douglas-rushkoffs-present-shock-the-end-of-time-is-not-the-end-of-the-world/

Yarow, J. (2013): 'The iWatch Could Be The First Step In Apple's Plan To Kill The iPhone', Business Insider, http://www.businessinsider.com/the-iwatch-could-be-the-first-step-in-apples-plan-to-kill-the-iphone-2013-1

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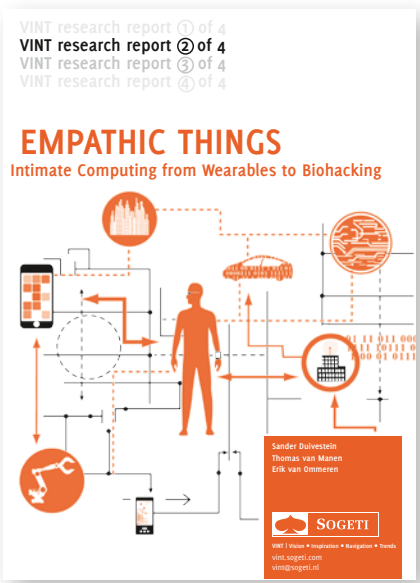

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